Intentional Engineers: Reflection and Mindfulness in Engineering Classrooms

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Stanford University
INTRODUCTION
Workshop Structure

Introduction & The CPREE context and opportunity

Part 1: Why contemplative practices in engineering education?

Part 2: Operationalizing mindfulness - 3 strategies
- “Not Doing”
- Mindful listening
- Mind-body connection

Part 3: Operationalizing reflection - 2 strategies
- Homework and exam wrappers
- ePortfolios

Part 4: Group Discussion

Further resources & Concluding remarks
Ingredients for Discovery

What you bring

- Interest in reflection and mindfulness
- Experience working with students and/or being a student

What we offer

- Reflection and mindfulness activities
- Questions to guide exploration of reflection and mindfulness
A reflection consortium

Consortium to Promote Reflection in Engineering Education (CPREE)

The Leona M. and Harry B. Helmsley Charitable Trust

Cataloguing 120 examples of reflection in engineering education across 12 campuses (Year 1)
  - Semi-structured interviews, field guides,

Promoting reflection (Year 2)
  - Learning communities, reading groups, workshops
PART 1: WHY CONTEMPLATION?
What activities, words, and/or images do you associate with “contemplation”?
“No problem can be solved by the same kind of thinking that created it.” – A. Einstein

- Mindfulness
- Reflection

- Focus and attention building
- Deeper understanding
- Connection and compassion
- Personal meaning
What do we mean by mindfulness?

Process: mindfulness practice
Outcome: mindful awareness

non-judgment, acceptance present moment awareness
What do we mean by reflection?

**Reflection:**
Dedicating time...

to examine past experiences...

to inform future action

CPREE
CONSORTIUM TO PROMOTE REFLECTION IN ENGINEERING EDUCATION
PART 2: OPERATIONALIZING MINDFULNESS
Benefits of mindfulness in the classroom

Openness to new information
Implicit awareness of more than one perspective
Flexible thinking
Heightened consciousness of problems
Increased quality of attention
Increase in working memory capacity
“Not Doing”

“Opening the Contemplative Mind in the Classroom” Tobin Hart, 2004:

“Take a few deep, slow, clearing breaths. Let your body release and relax; let any parts of you that need to wiggle or stretch do so. Now feel the gentle pull of gravity and allow the chair you’re sitting on, and the floor beneath you, to support you without any effort on your part. Just let go and allow yourself to be silent and not do for a few minutes. You may want to focus only on your breathing, allowing it to flow in and out without effort. If you find yourself thinking, distracted, working on a problem, don’t fight it, don’t get stuck in it. Just allow it and you to be, and redirect your awareness back to your breath, and to not doing.”

2-3 minutes of silence

“As you gently come back to the room you may notice the sensations of peacefulness, a clearer mind, or perhaps a feeling of centeredness.”
let’s breathe
Mindfulness is especially important in design thinking.
Meditation and yoga are techniques that bring us into the present, allowing us to tap into our innate confidence and creativity.

Just like we practice our analytical skills, we must practice our empathic skills.

This practice allows us to:

- Access the unconscious problem solving part of the brain
- Increase the mind-body connection
- Move from analytical/critical to generative/non-judgemental
- Induce a state of transient hypofrontality or “flow”
- Abandon judgment and fear to increase openness and creativity

*adopted from “Mindfulness Practices For Better Design” by Irene Au + concepts from the Stanford d.school
Mind-body connection

Yoga poses
- open shoulders/chest – “heart openers”
- side stretches – openness to ideas/people
- hip-openers – playfulness, creativity
Mindful listening

Has a teacher ever changed your life? How so?

Listen in silence

Give full attention to speaker

Be curious but don’t ask questions while listening

If the speaker runs out of things to say, give him/her the space for silence
PART 3: OPERATIONALIZING REFLECTION
Benefits of reflection in the classroom

Draws from the work of Schön’s *Reflective Practitioner*, Kolb’s experiential learning cycle, John Dewey

Transforming information → knowledge that can be re-used and transferred

Providing structured reflection is critical to meaningful academic learning

Potential to inform both students and the teaching team
Why is reflection important?

As people we...
- ...are constantly interpreting (making meaning of) experiences.
- ...rarely dedicate time to interpret experiences.
- ...tacitly interpret experience.

Multiple ways of interpreting experiences
WRAPPERS
What are Wrappers?

Exam wrappers are “structured reflection activities that prompt students to practice key metacognitive skills after they get back their graded exams” (Lovett 2013).
How to Wrap Assignments?

Assignment 1
- Wrapper Conducted
- Wrapper Returned

Assignment 2
- Wrapper Returned
- Assignment 2 Wrapper Conducted

Assignment 3
- Wrapper Returned

Time
Let’s talk about wrappers!

A wrapper used in an introductory statics course is given as an example. Find a partner and discuss:

- What could you modify with the wrapper provided for you context (addition or removal of certain sections etc.)?
Students said...

“I implemented both. I did not get any points off this time for issues with directions in the homework.”

“Yes, my mistakes of HW3 are not repeated in HW4.”

“I did all these things and it helped.”

“Signs were not a problem anymore. Success!”
Let’s look at more evidence

![Bar chart showing Type of General Mistakes Identified by Students]

- HW3: 1.23
- HW4: 0.76
- EXAM2: 0.87

[Chew et. al 2016, ASEE]
EPORTFOLIOS
ePortfolios and Folio Thinking

**Portfolio:** A purposeful selection of artifacts together with reflections that represent some aspect of the owner’s learning

A culture of **Folio Thinking** provides structured opportunities for students to:

1. create learning portfolios
2. reflect on learning experiences emphasizing integration, synthesis, and self-understanding
Showcase ePortfolio

Focus: the ePortfolio *product*

Purpose: *Outward* facing

Audience: Employers, grad schools, professionals, the *public*

Learning ePortfolio

Focus: the ePortfolio *process*

Purpose: *Exploratory, Developmental*

Audience: *Selected* advisors, mentors, family, peers
Learning Outcomes (Undergraduate)

The department expects undergraduate majors in the program to be able to demonstrate the following learning outcomes. These learning outcomes are used in evaluating students and the department’s undergraduate program. Students are expected to demonstrate:

1. an ability to apply knowledge of mathematics, science, and engineering.
2. an ability to design and conduct experiments, as well as to analyze and interpret data.
3. an ability to design a system, component, or process to meet desired needs.
4. an ability to function on multidisciplinary teams.
5. an ability to identify, formulate, and solve engineering problems.
6. an understanding of professional and ethical responsibility.
7. an ability to communicate effectively.
8. the broad education necessary to understand the impact of engineering solutions in a global and societal context.
9. a recognition of the need for and an ability to engage in life-long learning.
10. a knowledge of contemporary issues.
11. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
12. the ability to apply advanced mathematics through multivariate calculus and differential equations.
13. the ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.
An ability to function on multidisciplinary teams
Current Advising Paradigm

Transactional

Asynchronous Online: Student emails advisor a question and advisor answers

Shallow

Face-to-face: Student and advisor engage in mundane small talk, and re-introductions
Identifying needs, then resources

- ME exploration and educational advising
- Major advisor (Current Professor)
- What advice on course planning in ME? Current classes to try to avoid taking what would I get out of specific classes?
- Career advising, insight into industry relationships and interests
Using artifacts to facilitate reflection

ME 14N: How Stuff is Made

In How Stuff is Made, I had my first hands-on experience with the design process. In my group, I had the opportunity to find a problem and apply a solution. We found that razors we use everyday were not sustainable and produced a lot of waste. In SolidWorks, we designed and 3D printed a solution. We projected estimate costs and cutbacks in waste produced.
Integrating Across Experiences via Reflection

Mechanical Design

Project Management

Software Design
ePortfolio Platforms

Digication: https://stanford.digication.com


Stanford individual website options: https://uit.stanford.edu/guide/website/personal

Stanford Profiles: https://profiles.stanford.edu/

Stanford Sites: https://uit.stanford.edu/service/web/stanfordsites
PART 4: DISCUSSION
Your thoughts & questions?

What kinds of reflective activities are you personally engaging in or using with your students?

How can reflection and contemplative learning enhance and extend teaching & learning?

Pragmatically, what additional resources, support, evidence would you need to design and implement these activities?
Meta-reflection

From this workshop...

- One realization I had is _____.
- My next step with mindfulness and/or reflection is _____.
- I’d like to learn more about _____.

Thank you for your time and engagement!
FURTHER RESOURCES
http://cpree.uw.edu

**Campus: Georgia Tech**

**11. Exam Wrappers: Reflecting on Study Skills**

**Educator:** Carrie Shepler, Director of Freshman Chemistry  
**Context:** Out of class; Introduction to Chemistry series  
**Keywords:** exam, study skills, exam-taking skills, first-year students, metacognition  
**Student Activity Time:** 10 minutes outside of class

After an exam, students reflected on their exam preparation, their performance on the exam, and their preparation for future exams.

**Recreating the Reflection Activity**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduce students to the optional exam wrapper assignment.</td>
</tr>
<tr>
<td>2</td>
<td>Grade the exam wrapper assignment using a credit for completion approach.</td>
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<tr>
<td>3</td>
<td>Debrief students based on what you see in the exam wrappers.</td>
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